SECOND EDITION

Principles of Biochemistry

with an Extended Discussion of Oxygen-Binding Proteins

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WORTH PUBLISHERS

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Printed in the United States of America

Library of Congress Catalog Card No. 94-60553

ISBN: 0-87901-500-4

ISBN: 0-87901-711-2 with supplement

Printing: 9 8 7 6 Year: 00 99 98 97

Development Editor: Valerie Neal

Design: Malcolm Grear Designers

Art Director: George Touloumes

Project Editor: Elizabeth Geller

Production Supervisor: Sarah Segal

Layout: Patricia Lawson

Picture Editor: Stuart Kenter

Illustration Design: Susan Tilberry

Illustrators: Susan Tilberry, Alan Landau, and Joan Waites

Computer Art: Laura Pardi Duprey and York Graphic Services

Composition: York Graphic Services

Printing and binding: R.R. Donnelley and Sons

Cover: The active site of the proteolytic enzyme chymotrypsin, showing the substrate (blue and purple) and the amino acid residues (red and orange) critical to catalysis. Determination of the detailed reaction mechanism of this enzyme (described on pp. 223–226) helped to establish the general principles of enzyme action.

Frontispiece: A view of tobacco ribulose-1,5-bisphosphate carboxylase (rubisco). This enzyme is central to photosynthetic carbon dioxide fixation; it is the most abundant enzyme in the biosphere. Different subunits are shown in blues and grays. Important active site residues are shown in red. Sulfates bound at the active site (an artifact of the crystallization procedure) are shown in yellow.

Cover, frontispiece, and part opening images produced by Alisa Zapp (see *Molecular Modeling* credits, p. IC-4) and enhanced by Academy Arts.

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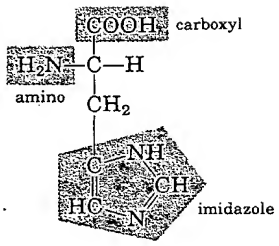
Worth Publishers

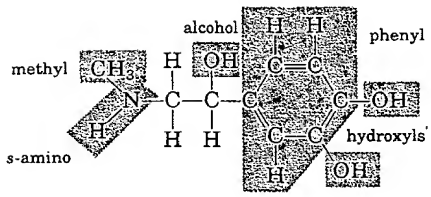
33 Irving Place

New York, NY 10003

Many biomolecules are polyfunctional, containing two or more different kinds of functional groups (Fig. 3–6), each with its own chemical characteristics and reactions. Amino acids, an important family of molecules that serve primarily as monomeric subunits of proteins, contain at least two different kinds of functional groups: an amino group and a carboxyl group, as shown for histidine in Figure 3–6. The ability of an amino acid to condense (see Fig. 3–14e) with other amino acids to form proteins is dependent on the chemical properties of these two functional groups.



Histidine



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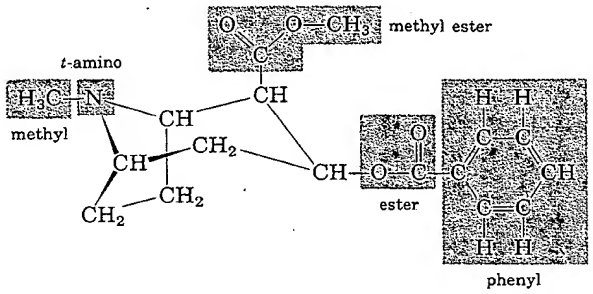
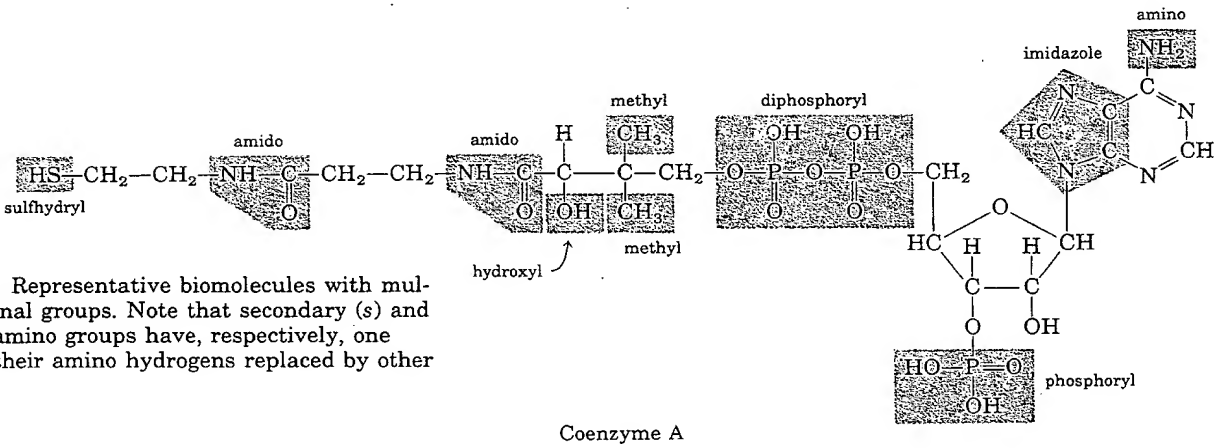


Cocaine



Coenzyme A

Figure 3–6 Representative biomolecules with multiple functional groups. Note that secondary (*s*) and tertiary (*t*) amino groups have, respectively, one and two of their amino hydrogens replaced by other groups.

Three-Dimensional Structure

Although the covalent bonds and functional groups of biomolecules are central to their function, they do not tell the whole story. The arrangement in three-dimensional space of the atoms of a biomolecule is also crucially important. Compounds of carbon can often exist in two or more chemically indistinguishable three-dimensional forms, only one of which is biologically active. This specificity for one particular molecular configuration is a universal feature of biological interactions. All biochemistry is three-dimensional.